PITTSBURGH INDUSTRIAL DISTRICT,
WORLD WAR II STRUCTURES
Pittsburgh
Allegheny County
Pennsylvania

HAER No. PA-343

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HISTORIC AMERICAN ENGINEERING RECORD

PITTSBURGH INDUSTRIAL DISTRICT - WORLD WAR II STRUCTURES

HAER No. PA-343

Location: Pittsburgh region, Allegheny, Beaver, Washington and Westmoreland Counties, Pennsylvania

Dates of Construction: 1941-45

Significance: The military procurement program during World War II had a significant impact on the social and economic development of southwestern Pennsylvania. In the depression decade before the war, the region suffered more than the rest of the country because its dependence on the production of steel producer goods made it particularly vulnerable to the severe contraction in the American economy.

The onset of the defense build-up and war-time environments, which brought important, if ephemeral, industries to the region and resulted in the modernization of productive equipment among established manufacturers, ameliorated economic conditions over both the short and, to a lesser degree, long term, in addition to significantly upgrading the skill level of the regional workforce. Also, the intra-regional character of migration patterns during the war made it possible for federally-funded public/private efforts to both enhance living conditions for war-production industrial workers and provide a small but significant long term improvement to the area's housing stock.

Project Information: This overview report on the defense-related industrial and housing expansion in the Pittsburgh region during the World War II years was prepared under the auspices of the U.S. Department of Defense Legacy Resource Management Program, cosponsored in 1994 by the Historic American Engineering Record. This study also included site reports on Mesta Machine Company at Homestead Steel Works (HAER No. PA-301), Munhall Homesteads (HAER No. PA-303), and Aluminum City Terrace (HAER No. PA-302).

Historian: Joel Sabadasz

Steel Production for War: The Impact of World War Two on the Pittsburgh Industrial District

The military procurement program during World War Two had a significant impact on the social and economic development of southwestern Pennsylvania. In the depression decade before the war, the region suffered more than the rest of the country because its dependence on the production of steel producer goods made it particularly vulnerable to the severe contraction in the American economy. Compounding the region's difficulties, a long-standing dwellings deficiency put southwestern Pennsylvania into the bottom ranks of the country in terms of its percentage of adequate housing.

The onset of the defense build-up and war-time environments, which brought important, if ephemeral, industries to the region and resulted in the modernization of productive equipment among established manufacturers, ameliorated economic conditions over both the short and, to a lesser degree, long term, in addition to significantly upgrading the skill level of the regional workforce. However, the basic character of the area's industrial economy remained unchanged, leaving it as vulnerable to the whims of the national economic cycle as it had been before the war. By contrast, the intra-regional character of migration patterns during the war made it possible for federally-funded public/private efforts to both enhance living conditions for war-production industrial workers and provide a small but significant long term improvement to the area's housing stock. The longevity of federal war-time housing was due, in large part, to the principle of cooperative-ownership, which took root partly because of terms laid down by congress for the post-war disposal of government-owned residential communities.

Regional Development

Consisting of Allegheny, Beaver, Washington, and Westmoreland counties, the land making-up the southwestern Pennsylvania study area is co-extensive with the Pittsburgh industrial district. Geographically, it is made-up of an extensive river system composed mostly of high bluffs and hilly terrain centering upon the confluence of the Monongahela, Allegheny, and Ohio Rivers at Pittsburgh. Running along the above named rivers and their tributaries, the region was marked by the presence of numerous industrial communities at the beginning of World War Two. Dominated by the iron and steel industry, they were located within a 30 mile radius of Pittsburgh and included, among others, the Ohio River towns of Ambridge, Aliquippa, Beaver Falls and Monaca; the Chartiers River city of Washington; the Monongahela River communities of Braddock, Homestead, Duquesne, Dravosburg, McKeesport, Clairton, Donora, Monessen, and Charleroi; the

Allegheny river towns of Millvale, Blaw Knox, and New Kensington; the Turtle Creek communities of East Pittsburgh and Wilmerding; and the Kiskiminetas River town of Vandergrift.

Underlying the entire region and extending southward into West Virginia, westward into Ohio, and eastward to the Appalachian Mountains, a vast coal bed -- the Pittsburgh seam -- provided much of the fuel needed to power the industrial activity in the district, producing nearly 35% of the nation's coal on an annual basis between 1890 and 1920. A particularly important segment of the Pittsburgh seam -- the Connellsville coal field -- was located approximately 45 miles southeast of Pittsburgh. Running on a southwest to northeast axis through Fayette and Westmoreland Counties, the 42 mile long x 3 ½ mile wide Connellsville field contained the best known metallurgical coking coal in the country. Between 1890 and 1910, it annually produced from 63% to 74% of the country's coke in beehive ovens. Even after by-product coking displaced beehive practice during World War One -- partly because by-product ovens were capable of producing high quality coke from heretofore inferior coals -- the region, as a whole, produced more than 40% of the nation's coke until 1920.[1]

Although industrial activity in and around Pittsburgh existed prior to the discovery of the Connellsville field, its nearness to the coking seam resulted in a striking increase in iron and steel production, which formed the core of the district's developing industrial complex, in the last third of the nineteenth century. Beginning at the southside of Pittsburgh and spreading out into the surrounding communities of Braddock, Homestead, and Duquesne during the 1870s and 1880s, the industrial district grew on narrow river front plains to its present size by the end of the second decade of the twentieth century, through the efforts of local investors. In the process, the region became a focal point of the country's second industrial revolution.[2]

The significance of the district's development for the growth of the nation's iron and steel industry rested upon its leading role as the site of major innovations in the coordinated fields of plant layout design, technological development, and financial accounting, for the production of producer durable and heavy semi-finished iron and steel products. The seminal event in the coordination of these innovations occurred at Braddock in 1875 with the greenfield construction of the Edgar Thomson Works. Built for Andrew Carnegie by Alexander Holley, America's leading expert on the design of bessemer steel rail mills, the construction of the works set the industry standard for maximizing the possibilities of increasing productive output offered by greenfield construction. As a result, mass production was pioneered by the efficient coordination of manually operated, mechanically powered, large capacity, material handling, steelmaking, and rolling equipment for the attainment of optimal speed of production through the works.[3]

From the outset of operations, Carnegie's financial managers and engineers combined to set the standard for financial management by consciously seeking to increase profits through the reduction of unit manufacturing costs. Company executives, as a result, revolutionized firm management through the invention and installation of more automatic production equipment, in order to reduce labor costs; the purchase of rival facilities possessing more modern equipment; and by integrating backwards in order to control material costs.

In the twenty-five years after Edgar Thomson's construction, for example, Carnegie's steel firm gained and maintained productive leadership within the industry by setting the American standard for blast furnace practice through 'hard driving' thereby providing the massive quantity of iron needed to run its steelmaking equipment on a continuous basis; the conscious design and/or installation of increasingly more automatic rolling mill and forging equipment, resulting in the reduction of labor requirements; the purchase of rival facilities with more modern equipment at Homestead and Duquesne; the acquisition of the vast coal and coke holdings of Henry Clay Frick and of iron ore mines in northern Michigan as well as the purchase of a shipping fleet and railroad to transport the coal, coke, and ore. In addition, the company expanded its product line beyond rails to include such producer durable and heavy semi-finished shapes as blooms, billets, merchant bars, rods, plates, armor plate, heavy forgings, and structural beams. As a result, it gained all time record profits for the industry, netting nearly $40,000,000 in 1901 alone. Once, moreover, the implications of Carnegie's management practices were understood by other iron and steel manufacturers, they were widely adopted both within the region and in the country at large.[4]

Within the region, the company's financial success eventually led the district's two largest wrought-iron producers, the National Tube Works Company in McKeesport and the Jones and Laughlin Steel Company's (J & L) Pittsburgh Works, into the exclusive production of producer steel goods. In addition, during the period between 1890 and 1907 several large-scale, fully integrated steel mills of the same variety underwent greenfield construction, including the Monessen Works of the Pittsburgh Steel Company, the Donora Works of the American Steel and Wire Company, the Aliguippa Works of J & L, the American Bridge Company in Ambridge, the Midland Works of the Crucible

Steel Company, and the St. Clair Steel Company at Clairton.[5]

Complementing the big steelmakers were a myriad of smaller iron and steel companies. These firms exploited specialized niches in iron and steel markets for semi-finished and finished goods, often through the production of alloy steel products. Some of the more important firms in this sector included the Allegheny-Ludlum Steel Works in Brackenridge, the Firth-Sterling Company in McKeesport, the McConway and Torley Company in Pittsburgh, the Braeburn Alloy Steel Company in Braeburn, the Edgewater Steel Company in Oakmont, and the Jessup Steel Company in Washington. Together, big and small steelmakers in the area accounted for slightly more than 31% of the nation's total ingot capacity in 1901, by far the largest percentage of any district in the country. Even more reflective of the region's leading position in the industry, Allegheny County alone produced 38% of the nation's ingots in that year.[6]

Iron and steel manufacturers were supplied and serviced by numerous firms in the district, some of whom purchased heavy semi-finished steel products from their customers in order to manufacture the products that supplied and serviced them. Prominent among the industrial groups which supplied iron and steelmakers were the producers of steelmaking equipment, the mining equipment industry, the heavy electrical machinery industry, railroad equipment manufacturers, and the tow boat and barge building industry.

Among the producers of steelmaking and mining equipment, there were in 1916, for example, 130 foundries producing a wide range of products, including blowing engines, rolling mill engines, several different types of rolling mills, forging presses, and assorted mining equipment. The heavy electrical machinery industry was led by the Westinghouse Electric Manufacturing Company, founded by George Westinghouse in 1888. Work conducted at the company's East Pittsburgh Works made it a pioneer in the development of alternating electric current as well as in the development and production of large-scale electrical power equipment used in steel mills, most notably the turbogenerator, the motor-generator, and the rolling mill engine. As a whole the Pittsburgh district was a vital center of national production in the heavy electrical machinery industry, producing 38% of the nationwide total on the eve of the great depression.[7]

George Westinghouse was also prominent in the development of the railroad equipment industry, particularly with respect to the invention and productive development of the air-brake and railroad signaling apparatus. Invented to solve historically persistent braking problems within the railroad industry, the air-brake, which was produced at the Westinghouse Air-Brake Company at Wilmerding, became standard equipment on the railways by significantly decreasing brake-related accidents through more powerful application. Likewise, railroad signaling equipment, produced at the Union Switch and Signal Company in Swissvale, enhanced safety through the utilization of electropneumatic signaling which interlocked with rail switching gear to prevent the possibility of derailments by accidental switching. Taken together, the Westinghouse Air-Brake Company and the Union Switch and Signal Company became the nation's leading suppliers of pneumatic and electropneumatic railroad equipment.[8]

The tow boat and barge building industry gained prominence in the region about the time of World War One when the Dravo Corporation, a leading construction firm specializing in the building of industrial power plants, bridge substructures, and locks and dams, designed and built its first steel barge at its Neville Island marine ways. The design of this barge, which was original with Dravo, became standard in the trade for the transport of coal and other bulky products. In succeeding years, the district's barge building industry grew to become a major supplier of tow boats and barges for the entire Mississippi basin and included such major firms as Dravo, the American Bridge Company, the Jones and Laughlin Company, and the Hillman Barge and Construction Company.[9]

In addition to the iron and steel industry and its suppliers, the district was the birthplace of the nation's aluminum industry. Based on the electrolytic process for smelting bauxite originally developed by Charles Martin Hall, the Pittsburgh Reduction Company, renamed the Aluminum Company of America (ALCOA) in 1907, operated the country's first full-scale aluminum production and fabrication plant at New Kensington in 1891. Its New Kensington headquarters, moreover, controlled every aspect of the nation's aluminum industry from bauxite mining to the production of semi-finished and finished products until the late 1940s.[10]

The rapid pace of industrial development in the district led to a boom in population growth. Between 1880 and 1920 the population of the city of Pittsburgh, for example, more than doubled, rising from roughly 234,000 to 588,343, mostly through the migration of eastern and southern Europeans and African-Americans into the community. In surrounding Allegheny county, population growth was just as spectacular, reaching 1,018,463 in 1910, while the entire four county area grew to 1,471,800.

A particularly significant component of this expansion was the emergence of several iron and steel production centers along the

Monongahela river as significant sites of population growth. Between 1870 and 1910, for example, the populations of McKeesport, Braddock, Homestead, Duquesne, and Monessen (established in 1898) cumulatively rose from 6,048 to 108,141 or just over 1800%. Like the city of Pittsburgh, eastern and southern Europeans and African-Americans made up a large percentage of the growth, accounting for nearly 50% of the total expansion.[11]

The large influx of immigrants into the area -- most of whom filled low paying semi- and unskilled industrial jobs -- resulted in a residential building program by local real estate interests which embodied the worst features of boom-time construction as immigrant families were generally herded into substandard, segregated communities located near smoke and noise congested mills and factories. Homestead's second ward, an eastern European community adjacent to the Homestead Works, was a characteristic example of working-class housing in the district. An intensive study of 21 courts in the ward conducted by Margaret Byington for the Pittsburgh Survey in 1907, revealed 239 families (102 of whom took in lodgers) sharing yard, toilet, and water facilities. Indoor running water could be found in only three houses and in some cases more than 100 persons procured their water from one yard pump. No indoor toilets, moreover, existed in the study area. Although a few houses were four to six stories high, the majority were two stories with four rooms. All lacked sufficient light and ventilation. Normally two families occupied a typical two story dwelling. Among households which took in lodgers, however, as many as 20 men could be found sharing two rooms with the family occupants.[12]

Although attempts to alleviate housing conditions made some headway through local taxpayer financed sewer and water line extension programs in the 1910s and through federally subsidized public/private efforts during the 1930s, including W.P.A. street paving programs and the inauguration of a low-income slum-replacement construction program, the substandard condition of working-class housing remained persistent. On the eve of World War Two, nearly 10% of Pittsburgh's housing contained more than 1.51 person's per room, the federal standard for indicating crowded living conditions. Only St. Louis ranked worse among cities of Pittsburgh's size. In addition, 43.5% of the city's household units were in need of major repairs or lacked a private bath. For the four county area as a whole, the figures were progressively worse as 44.4% of Allegheny county dwellings suffered from a need for major repairs or lacked a private bath, 44.7% in Beaver county, 60.9% in Westmoreland county, and 65.5% in Washington county.[13]

The ability of the local private housing industry to provide adequate working-class shelter, not evident in the spectacular growth years of the region's industrial development, failed to improve significantly in later years because persistently low industrial wage-rates in the district combined with gradually declining growth rates, relative to other domestic iron and steel producing centers, after 1904 to produce a poor environment for speculative investment in low-income housing construction. Although the district continued to lead the nation in total steel production, its share fell from 40% in 1904 to 25% in 1934. The decline, in large part, was due to the growth of industrial steel consumption in the midwest, amounting to 42% of the national total in 1935, which led to the development of rival steel producing districts in Chicago, Cleveland, and Detroit. The favorable location of these centers, in terms of lessened raw material and product shipment costs, not only led them to compete with the Pittsburgh district for midwestern producer durable and heavy semi-finished steel markets, but also led them to take advantage of newly developed hot strip mill technology after 1929 to become the dominant supplier for the high growth consumer durable goods industry -- automobiles, heating and cooking apparatus, and refrigerators. Between 1929 and 1939, the production of strip steel gained increasing importance within the iron and steel industry, rising from 18.9% to 30.4% of the country's annual total of hot rolled steel products, while the production of plates, structural shapes, and rails -- staples of the Pittsburgh district -- fell from 30.5% to 19.9%.

The region's declining lead in the production of iron and steel products, was mirrored by a decline in plant reinvestment among major steelmakers, relative to rival production centers. The district's percentage of the United States Steel Corporation's investment in productive facilities, for example, declined steadily between 1906-1940 in comparison to the corporation's stake in midwestern, southern, and west coast plants. Although more potent and efficient electrically-powered slab, plate, and seamless tube mills were installed at the Corporation's mammoth works at Braddock, Homestead, and McKeesport during the period, its blast furnaces and rolling mills at the equally huge Duquesne and Clairton Works continued to be powered, for the most part, by outmoded reciprocating steam engines. Despite, moreover, a belated attempt by regional iron and steel manufacturers to produce for the consumer durable goods industry through the construction of hot strip mills at Dravosburg (The Irvin Works of the United States Steel Corporation) and at the Pittsburgh Works of J & L in 1937, the district became only a secondary supplier of strip steel, remaining predominantly oriented to producer goods.[14]

The product orientation of the region's core iron and steel industry made it particularly sensitive to the national economic cycle. During periods of national economic growth, rising levels of new building construction, plant expansion, and industrial equipment replacement programs resulted in thriving conditions for the area's steelmakers, equipment producers, and heavy machinery manufacturers. When, however, the economy entered periods of contraction, most business and manufacturing firms eschewed expansion programs for cutbacks in existing capacity, resulting in a disproportionate decline, relative to the nation as a whole, in regional economic activity.

At no time was the vulnerability of the district's dependence on the production of producer goods more evident than in the depression decade of the 1930s. In several important indicators of manufacturing production, the region's decline was significantly greater than the dramatic contraction experienced across the country, while its recovery lagged behind the nation as a whole. From the depression eve to its nadir in 1933, for example, the value of manufactured products made in the United States fell by 52%. Value within the Pittsburgh district declined by 67.2%. By the eve of the military build-up, the value of the country's manufactured products recovered to 83.4% of their 1929 total as compared to only 66.6% for the Pittsburgh district. Likewise for the percentage of gainfully employed manufacturing wage-earners which fell nationwide by 32% in 1933 from its predepression highs, before recovering to 92% of the 1929 total at the end of the decade. Within the region, manufacturing employment tumbled by 37% from 1929 to 1933 before rising to only 84.2% of its predepression total in 1939. In terms of total wages paid manufacturing workers, finally, the United States total declined by 55% between 1929 and 1933, while regional rates fell by 65%.[15]

War-Time Development

a.) Federal Policies and Programs:

In the spring of 1940, just prior to the defeat of the French and British forces by the blitzkrieg tactics of Nazi German aircraft and panzer units, the United States military ranked sixteenth in the world. Blitzkrieg warfare was successful because of superior aircraft, tanks, mobile units, artillery, anti-tank and anti-aircraft guns, all of which were woefully lacking in the American military. While the German Luftwaffe consisted of 25,000 planes, the United States Army Air Corps had 2,665 planes on hand. As opposed to several thousand German Mark III and Mark IV tanks, which pushed the British and French armies back into the sea and later struck deep into the Soviet Union, the United States had no heavy tanks at all, 144 medium tanks, and 648 light tanks on hand or on order. Whereas motorized

German panzer units swept easily across western Europe, the U. S. military was still in the early stages of motorizing its horse cavalry regiments. In the field of artillery, the United States lagged behind all of the European powers in the development of new weapons. Furthermore, a significant percentage of ammunition for the American military consisted of deteriorating World War One stocks.

In addition to an obvious need to build up its own military forces in the face of an expansionist aggressor, the United States pledged the fulfillment of $7.27 billion of material goods to the British and Soviet allies through the auspices of lend-lease in 1941. The $7 billion British share of this total consisted mostly of munitions, particularly aircraft, tanks, artillery, machine guns, rifles, and bomb shells, while the $270 million Soviet share consisted primarily of industrial equipment and facilities.

Although, moreover, the nation was considered to have a reasonably adequate one ocean naval force on the eve of European hostilities, the United States Navy was devastated by the Japanese attack at Pearl Harbor which destroyed or seriously disabled all eight American battleships stationed there, or nearly half of the nation's entire complement of capital ships at that time. Furthermore, a string of early allied defeats in the Pacific Ocean, leading to the fall of Singapore and the Philippine Islands, cut off far eastern trade routes, and led to the almost complete loss of the nation's natural rubber and tin supplies, which were crucial for motorizing the army and preserving the food which was needed to feed millions of American soldiers.

The subsequent entry of the United States into the war against the Axis powers made it imperative to build up the country's naval, air, and ground forces for a two ocean offensive. As a result, between July of 1940 when the nation's munitions production program began until August of 1945 when the Japanese surrendered, the total value of munitions produced in the country equaled $183.1 billion dollars. Of this amount, aircraft accounted for $44.8 billion, ships for $41.1 billion, guns and fire control for $9.8 billion, ammunition for $18.1 billion, combat and motor vehicles for $20.3 billion, communications and electronic equipment for $10.8 billion, and other equipment and supplies for $38.2 billion.[16]

The total munitions output resulted from coordination between federal wartime agencies and private industry in the conversion of industrial production from civilian to military consumption. This took place in several interrelated fields including the transfer of existing industrial processes from the production of civilian to military goods; the expansion of industrial capacity to meet the enormous military demand; the creation of new industrial processes and facilities; the equitable disbursement of critical manufacturing and construction materials; the training of essential industrial war-production workers; and the housing of those workers.

Nationally, this meant that major industries like steel and automobile manufacturing converted from the production of civilian producer goods and passenger vehicles to the production of heavy plate, armor plate, and semi-finished rounds for the manufacture of tanks, armored cars, heavy guns, ammunition, and other military products. In addition, thousands of companies in widely disparate industries either wholly converted to military production or expanded their operations for the manufacture of such products as ships, landing craft, artillery guns, and ammunition shells.[17]

Because of the unprecedented military demand, the federal government, in conjunction with private manufacturers, dramatically expanded the capacity of strategic industries, including steel, aluminum, aircraft, shipbuilding, and ordnance. Expansion took place through private and public financing. In order to encourage private financing, which amounted to slightly more than 25% of the national total spent on wartime plant construction, congress approved a tax amortization program which allowed manufacturers to amortize the cost of new war-production facilities over a 5 year period. Federally-funded plant construction was financed directly by the War or Navy Department, and through their sponsorship or some other war agency under the financing program of the Defense Plant Corporation (DPC), a subsidiary of the Reconstruction Finance Corporation (RFC). The land on which the expansion took place usually belonged to the individual private companies which leased and managed the government-owned industrial equipment, often with the understanding that they would have the opportunity to purchase the machinery after the war. There were two types of leases. Companies engaged in the production of goods directly for the military paid $1 per year for the use of federally-owned equipment, while the rent for firms which produced semi-finished products for further processing at other war-production plants was based on the volume of its sales.[18]

In order to produce suitable substitutes for scarce materials, new strategic industrial processes were developed through public/private partnerships. Included among these were the processes for the production of synthetic rubber and electrolytic tin plate. DPC spent over $780,000,000 to build 39 industrial plants nationwide for the production of synthetic rubber under the sponsorship of the Rubber Reserve Company, another RFC subsidiary. Composed of equipment containing a significant percentage of critical alloy steels, they were managed by a number of important American chemical and rubber companies under the terms described above. The electrolytic tinning process was developed by the United States Steel Corporation and shared with its competitors for the production of tin plate for military needs.[19]

The tremendous expansion of new plant construction, resulting in a 50% increase of the nation's industrial capacity, as well as the trebling of manufacturing output from 1939 to 1944, created a crisis in the allocation of critical construction and manufacturing materials. After several attempts by the War Production Board (WPB) and its predecessor agencies to overcome bottlenecks in the completion of new plant construction and war-production contracts through different priority programs for regulating the flow of essential materials, it finally settled on the Controlled Materials Plan (CMP), which tied together control over materials with control over the individual production schedules of building contractors and manufacturing firms.[20]

Expansion of war-production led to the creation of 6.5 million manufacturing jobs between 1939 and 1943. Because the American military augmented its forces by 11 million during the same period, a significant percentage of the new workers were untrained in industrial work, including many of over 2 million women, whose participation in the war-production workforce grew by 460% from the beginning to the end of the war. In order to impart the requisite skills for industrial work, a two-prong public/private training program was set-up by Sidney Hillman of the Amalgamated Clothing Workers (ACWA) of America for the National Defense Advisory Commission (NDAC) in 1940. Concentrating primarily on training-within-industry under the direction of individual private companies, the program was supplemented by federally-financed vocational training through established schools. By the end of the year, moreover, a program for the intensive training of engineers had been worked out in cooperation with the country's engineering colleges.[21]

The influx of 6.5 million manufacturing jobs, an increase of more than 50% over 1939 totals, led to a vast migration of industrial workers to the nation's major war-production centers, estimated by the federal Bureau of Labor Statistics to equal 2.6 million workers plus dependents during 1943. In an effort to provide adequate shelter for the incoming migrants, congress approved a plan allowing the Federal Housing Administration (FHA) to encourage private construction of low-cost working-class housing located reasonably near war plants through guaranteed mortgage insurance and by priorities assistance for obtaining scarce building materials. As a result, more than half of all new residential units for war-production workers during the war were privately built, largely through the aid of FHA loan insurance.[22]

Because private construction could not meet the country's needs by itself, congress approved, under the Lanham Act and its successors, the construction of 614,000 federally-funded rental units for war-production workers between 1940 and 1944, including 192,000 permanent units, 252,000 temporary units, 56,000 'converted' units, 162,000 dormitory units, and 39,000 trailers. The program was financed through the United States Housing Authority (USHA), the central agency of the new deal slum-replacement program. It provided loans up to 90% of the capital costs for projects sponsored by federal war agencies, including the Public Buildings Administration, the Department of the Navy, and the Federal Works Administration's Division of Defense Housing.

Project initiative for the war-production housing program was open to any of the several sponsoring war agencies as well as to the local housing authorities, which had exercised proprietary rights over the new deal slum-replacement communities. Before disposition through USHA financing, all projects were nominally cleared by the Division of Defense Housing Coordination, an executive agency which ostensibly scheduled both the completion of individual projects and the allocation of building materials for them, as well as providing information on housing conditions and needs in critical war-production centers across the country. In 1942, the Division's functions were taken over by the National Housing Agency.[23]

Most permanent housing for war-production workers was assigned by the Federal Works Administration (FWA) to the USHA which, in turn, leased the new residential communities to the local housing authorities for their management. In addition, the local authorities were often involved in site selection as well as in the selection of private architectural, landscaping, utility installation, and construction firms either as an advisor to the FWA or as the primary agent of the National Housing Agency's Federal Public Housing Authority (FPHA). Under the FWA, architectural firms were hand-picked, while landscaping, utility installation, and construction firms were chosen on a competitive low-bid basis. In the latter arrangement, the local housing authority supervised the selection of the various firms associated with the building of war-housing communities under the low-bid policy, when available.[24]

Permanent housing was meant to meet adequate standards of living space and affordability for war-production workers and their families. Construction costs were ultimately limited by congressional mandate to a maximum of $4,500 per unit with the average cost per unit in each residential community not to exceed $3,750.

Typical units were one, two, and three bedroom domiciles set in row houses. Normally they were without basement, but were equipped with electric lights, hot and cold running water, installed heating equipment, and private toilet and bathing facilities. The kitchen was generally equipped with a range, refrigerator, sink, base cabinet, and shelving. Usually, a washing machine was provided in the kitchen or in a storage closet opening off the kitchen. The typical living room was large enough to accommodate a couch or davenport, two easy chairs, a desk or table, a radio, or other incidental furniture. Dining space was provided in the kitchen or in an alcove off the living room, whichever seemed to be preferred in the community. The master bedroom had space to contain twin beds, a dresser, a chair, and a child's crib. Other bedrooms typically contained enough space for twin beds, a dresser, and a chair. In addition, each bedroom had a closet and the typical unit as a whole included a coat closet, a linen closet, and general storage space.

Tenants for newly constructed communities were chosen by the local housing authorities on the basis of need for adequate low-cost permanent family housing located within reasonable public commuting distance from their war-production places of work. Shelter rents were originally grounded on a graded annual-wage system, averaging, nationwide, about 20% of the yearly income of the principal family wage-earner per unit. In September of 1941, a space rental system was adopted which fixed 'fair rentals' on family units based on their value as determined by the Administrator of the Division of Defense Housing Coordination. As a result, unit size, as measured by the number of bedrooms, became the primary determinant of rental rates.[25]

b.) The Pittsburgh District:

The Pittsburgh district was a significant center of the public/private effort to convert production from civilian to military goods, expending $511,000,000 on plant expansion during the war, the sixth largest total of the fifteen leading industrial centers in the country at that time. Of this amount, $347,000,000 or 68% was the direct result of federal funding. The iron and steel industry received $270,830,000 or 53% of the grand total, primarily for the expansion of capacity in the production of pig iron, carbon and alloy steel ingots, semi-finished shapes, plates, and heavy forgings.[26]

Pig iron capacity increased by 2,011,460 tons or about 13% of the national expansion, while the steel ingot capacity increase represented 20% of the nationwide total or 3,278,294 tons. The capacity for semi-finished shapes, primarily slabs for plate production and rounds for shell production, expanded by 1,968,761 tons over the district's pre-war total of 11,632,618 tons, which represented 21.8% of the country's semi-finished capacity at that time. The 1,901,084 ton expansion of plate capacity -- crucial for the production of armored ships, cargo ships, landing craft, armored tanks, and other heavy military vehicles -- more than doubled the region's nationwide leading hot-rolled plate total, while its cast steel plate capacity was augmented by 71,400 tons. In addition, the federal investment in the expansion of forged steel capacity, important for the production of armored plate, gun barrels, and shells, equaled $10,638,000.[27]

Production for military needs took place in the district's big and small iron and steel companies as well as in the firms which supplied and serviced them. The Carnegie-Illinois Steel Company, a subsidiary of the United States Steel Corporation, for example, managed a $123,587,987 Navy Department sponsored, DPC plant expansion consisting of blast furnace, electric furnace, open hearth, alloy heat treating, plate rolling, and forging facilities within the boundaries of its mammoth Edgar Thomson, Duquesne, and Homestead Works. In addition, the company spent in excess of $10,000,000 of its own capital to convert its 80-inch hot strip mill at Dravosburg and 32-inch structural mill at Homestead for the production of plates and rounds. Among smaller firms, the McConway-Torley Steel Company at Pittsburgh managed a $1,262,975 DPC expansion for the production of armored tank plate castings on property adjacent to its own, while the Jessup Steel Company at Washington spent $545,000 of its own capital and managed a $1,571,506 DPC expansion for the production of alloy steel plate.

Although armored plates were sent to ship and tank assembly facilities in other parts of the country, the majority of producer steel goods made in the district were used for the fabrication of military products by local firms. Rolled carbon steel plate from the region's big integrated iron and steel firms, for example, were used in the production of landing ship, tanks (LSTs) at the Ohio River shipyards of the Dravo Corporation and U. S. Steel's American Bridge Company. Alloy steel plate was fabricated into airplane propellers at the Curtiss-Wright plant in Beaver Falls. Likewise, semi-finished steel rounds from the big integrated firms were fabricated into bomb and artillery shells at numerous local firms, including the Westinghouse Air-

Brake Company, the Union Switch and Signal Company, and the Christy Park Works of U. S. Steel's National Tube Company at McKeesport. Forged artillery gun tubes were also produced at a number of local firms, including the Heppenstall Company at Pittsburgh and the Mesta Machine Company at West Homestead.[28]

The movement of steel goods from big and small steelmakers to national and local fabricators of military products can best be typified by describing the production activities of the Carnegie-Illinois, McConway-Torley, and Jessup Steel Company DPC facilities and their local fabricating counterparts, which included the Dravo Corporation, the Christy Park Works, the Curtiss-Wright Company, and the Mesta Machine Company. The DPC facilities at Braddock, Duquesne, and Homestead -- equivalent to a fully integrated iron and steel works -- were constructed to provide nearly one-fifth of the 10,000,000 ton steel capacity expansion authorized by the Office of Production Management (OPM) in 1941 for the Navy 'Speed-Up' Program. Although not possessing any major technological innovations, the expansion represented a thorough modernization of the iron and steel making process.[29]

The DPC blast furnace plant was constructed at the Edgar Thomson Works and added 860,000 tons of pig iron capacity to the district. Each of its two blast furnaces was 105' high with a hearth diameter of 27'-6". They were served by a previously existing automatic raw materials storage, handling, and delivery system, consisting of an ore yard and ore bridges, stock house, and skip-hoist loading gear for the charging of coke, limestone, and iron ore into the top of each furnace. Ore and limestone were reduced to a molten state through the ignition of coke by hot blast air, which was delivered under 20 pounds of pressure at a rate of 70,600 cubic feet per minute (cfm) by one of two new turbo blowers to 18 tuyeres ringing the furnace just above the hearth.

The blast air was heated to 1025 degrees F. by three, 25' diameter x 125' high, regenerative hot blast stoves per furnace. Constructed of steel plate, each cylindrically-shaped, domed stove encased a mass of checkerwork which was built around a combustion chamber running up the length of the structure. Waste blast furnace gas, cleaned at the plant's wet gas cleaning system, was ignited inside of the stoves to heat the checkerwork, which in turn, heated the blast air. The stoves operated on a 4-hour gas cycle and a 2-hour air cycle.

Chemical impurities, including silica, manganese, sulphur, and phosphorus, were fused into the limestone-based slag floating on top of the molten iron bath by oxidation. Each furnace was tapped 5 times per day into ladle cars which delivered the hot metal by rail to the open hearth mixer building. Daily pig iron production averaged 1020 tons.

Molten pig iron was converted into steel in the DPC basic open hearth furnace plant at Homestead. The plant contained eleven 225-ton refractory bricklined furnaces having a annual capacity of 1,700,000 tons. The steel framework of the 162' wide main building was supported on steel and concrete piling. The building's line of open hearth furnaces ran between its 85' wide x 1404' long charging aisle and 77' wide x 1944' long pouring aisle. The oil-fired, door-charged furnaces were loaded by three 12-ton ore and scrap stiff-leg charging machines set on top of wide-gauge rails and two 150-ton hot metal electric overhead traveling (E.O.T.) cranes, which transferred molten pig iron to the furnace from two 800-ton capacity mixers. Three 300-ton E.O.T. ladle cranes handled transfer operations in the pouring aisle.

Steel scrap, iron ore, and pig iron were heated inside of the 18' wide x 52' long shallow furnace hearth to a temperature of 3000 degrees F for about 10 hours. During this time, chemical impurities, including carbon, silicon, manganese, sulphur, and phosphorus, were gradually fused into a slag produced by the basic lining of the furnace through oxidation.

As the mixture cooked, hot waste gas was directed through flues to two regenerative checkerwork chambers and to a 7500 sq. ft. waste heat boiler. Located at each end of the furnace, the valve-operated chambers were heated by the waste gas in reversing fashion. As the checkerwork of one chamber was being heated, the checkerwork of the other provided heat for incoming combustion air, which was blown into it at a rate of 20,000 cfm by a forced draft fan. The waste gas was used as fuel for the boiler, which provided steam for powering the furnace's cooling water system and for heating and atomizing fuel oil.

Molten carbon or alloy steel was tapped into a teeming ladle, which was stationed in the pouring aisle under the furnace's tap hole. In addition to three large platforms where the molten steel was teemed into ingot molds from a plug-hole located at the bottom of the ladle, the aisle contained a 285' long x 20' wide x 21'-6" deep casting pit for receiving large ingots, up to 260 tons. After cooling for several hours, the ingots, which weighed from 10 to 25 tons apiece, were taken over narrow-gauge rails to the new DPC 45-inch universal slab mill or forging plant for further processing.

Alloy steel ingots were exclusively produced at the 165,000 ton annual capacity, DPC electric furnace plant in Duquesne. The main building of the plant consisted, respectively, of a 82' wide x 450' long stockyard aisle, a 80' wide x 450' long charging aisle, and a 75' wide x 525' long pouring aisle. Three magnesite bricklined, door-charged furnaces, one 35-ton and two 70-ton, ran in a line between the charging and pouring aisles.

Boxes of steel scrap were charged into the furnace by a 5-ton stiff-leg loading machine set on wide-gauge rails. Three 20" graphite electrodes, powered by one of two new 31,250 kva turbogenerators located at the Edgar Thomson Works, were then lowered into the furnace. The resulting 8-hour heat consisted of three stages -- melting, oxidizing, and reducing. Chemical impurities were removed during the oxidizing stage through the formation of a slag created by the oxidation of silicon, manganese, phosphorus, and carbon during scrap melting. After oxidizing was complete, the electrodes were removed and the slag was skimmed off the bath by hand. A new slag mixture, composed of burnt lime, fluorspar, silica sand, and powdered coke, was added to the bath in order to facilitate the addition of alloy material, including nickel, chromium, vanadium, and tungsten. The furnace was then restarted and the new mixture cooked for two final hours.

When ready for tapping, the furnace was tilted forward on a geared rocker and rack and the molten steel was poured into a ladle set upon a transfer car riding on wide-gauge rails. Subsequent to tapping, the ladle was carried by a 125-ton E.O.T. crane to a nearby platform where the steel was teemed into ingot molds. After cooling, the molds were delivered over narrow-gauge rails to the DPC forge shop at Homestead or to the Duquesne Works' 38-inch blooming mill for further processing.[30]

Ingots scheduled for the production of plate at the DPC Works were delivered to the ingot stripper building of the 1,352,000 ton annual capacity, 45-inch universal slab mill at Homestead, where they were stripped from their molds by two 200-ton hydraulically operated ram-type E.O.T. cranes. Upon stripping, the ingots were taken on their cars to the 100' wide x 600' long soaking pit furnace building, which contained 20 recuperative, natural and coke oven gas-fired pit furnaces lined up in two horizontal rows.

Four to six ingots were usually charged by a 25-ton E.O.T. crane into each 15' wide x 16' long x 13' deep furnace, which was designed to equalize the temperature throughout the ingot at proper rolling temperature. After heating from 3 to 18 hours, depending upon their charging temperature, the ingots were removed from the furnaces, and placed, individually, into an automatic, motor-powered ingot buggy, which delivered them over rails to the 45-inch slab mill approach table.

The 112' long motor-powered, shaft-driven, automatic roller table delivered each ingot to the 45" diameter horizontal and 36" diameter vertical rolls contained within the 45-inch roll-stand. Driven by two spindle-connected 5000 hp twin-drive motors, the rolls first removed furnace-scale from the top, bottom, and sides of the red hot ingot with the aid of high pressure sprays, before compressing it to precise dimensions -- ranging from 3" to 22" in thickness, 19" to 67" in width, and 70" to 144" in length -- by several reversing passes through them. During the operation, the distance between the rolls was continually adjusted by two, motor-powered screw-downs located at the top of the roll-stand over the ends of the rolls.

Upon compression, the slab was taken over an automatic roller table, at a rate of 100 feet per minute (fpm), through a high pressure oxygen, multi-jet fired scarfing machine, which removed surface defects from its vertical edges. The slab next moved 65' to the mill shear, which utilized an hydraulically operated upcut knife to cut it to precise length. It then traveled to a scale, where it was weighed, before being run out onto a motor-powered standard-gauge slab transfer car, which took several slabs by rail to one of two 100' wide x 675' long nearby storage yards for cooling and inspection. After surface defects were removed by hand scarfing, the slabs were finally moved a short distance over rail to the 108' wide x 468' long, 15,000 ton capacity 160-inch plate mill slab storage yard.

Six shallow, gas-fired preheating pits in the storage yard, each with a 50 ton, or 10 slab capacity, heated individual slabs to a temperature of 1600 degrees F. every 24 hours. Preheated slabs were taken by standard-gauge transfer cars over rail to the entrance of the mill's slab furnace building, consisting of two batch and two continuous furnaces. A 20-ton stiff-leg, swivel crane, running between the gas-fired batch furnaces, employed tongs to charge and draw individual slabs, which were heated to a rolling temperature of 2250 degrees F at a rate of 15 tons per hour. The recuperative, continuous furnaces were loaded from a charging table upon which individual slabs from the transfer car were placed by a 30-ton E.O.T. crane employing a magnet. A double rack pusher automatically moved the slabs through the 80' long, gas-fired furnace to the delivery table of the mill's scale-breaker roll-stand at a rate of 70 tons per hour.

Each slab was descaled with one pass through the 1600 hp, motor-powered scale-breaker, consisting of two 36" diameter x 70" long, alloy steel, fluted, screw-adjusted horizontal rolls and high pressure water sprays. From the scale-breaker, the slab was transferred by automatic roller table to the slab turntable, which rotated it by 90 degrees for the spreading pass through the 600,000 annual ton capacity, 160-inch plate mill 4-high roll-stand.

At the roll stand, the slab was cross-rolled by two 38" diameter x 160" long crowned, alloy iron, horizontal work rolls which were inserted between two 59" diameter x 154" long alloy steel, horizontal back-up rolls. A pair of 5000 hp, twin-drive motors, connected by spindles to each work roll, drove the automatic screw-driven rolls in 13 pre-set reversing passes as movable side-guards kept the slab squared and centered through the rolls. Slabs were compressed to 160" wide plates of various thicknesses up to 1 ½"

Upon leaving the main stand, the plate moved over a roller table for 216' to the hot leveler, while its top and bottom were sprayed with water, cooling it to a temperature of 1200 degrees F. The 4-high, screw-driven hot leveler, composed of two 13" diameter x 160" long bending rolls inserted between two 16" diameter x 160" long pinch rolls, straightened and flattened the plate in one pass through the stand.

After leaving the leveler, plates were delivered to one of three operations. Plates for armored ship decks were taken by a 30-ton E.O.T. crane to transfer cars which carried them to controlled-cooling hoods located in the mill's shipping building. Plates that were to be cut into assorted shapes were taken to one of two flame cutting facilities within the mill complex. All of the rest moved by roller table to a 120' wide x 108' long chain-driven transfer bed where the plates traversed to the 292' long marking table.

The marking table was equipped with a motor-propelled, operator driven, automatic measuring machine. The indexed longitudinal and transverse movements of the machine enabled the operator to mechanically mark-off any desired size of rectangular plate. As the plate rolled from the marking table to the crop shear, an identification mark was die-stamped or painted on it.

The down-cut, guillotine type, hydraulically-operated crop shear precisely sheared the front end, and occasionally both ends of the plate, which was held down by hydraulically-powered clamps or gags. In addition, the shear divided plates which were too long for subsequent transfer operations. Upon leaving the crop shear line, plates traveled over a run-in table to a 68' long x 84' wide chain-driven transfer table, which delivered them to the main shear line.

The main line ran parallel to the crop shear line in an opposite direction and consisted of two side shears, located 78' apart on opposite sides of the roller table, and an end shear, 84' beyond the second side shear. All three operated on the same principle as the crop shear. Screw-driven magnets aligned the plate for slicing at the side shears, while squaring pushers and two motorized gage stops on the respective entry and delivery sides of the end shear, aligned the plate and allowed it to be cut to predetermined lengths. Scrap shears, provided at each of the mill's shearing units, received scrap by conveyor to cut up into smaller pieces. After falling through chutes into buckets, the scrap was recycled at the DPC open hearth steelmaking plant.

From the end shear, the plates moved by roller table to a scale, where they were individually weighed before being taken by a magnetized 12-ton piler crane to a gravity table, which piled them on a chain-driven carriage. Overhead cranes subsequently moved the piles to the 110' wide x 1100' long shipping building.

The flame cutting areas, located, respectively, at the end of the shear building and down line from the continuous furnace building, were each equipped with three pantograph, sketch cutting machines. Designed primarily for intricate shape cutting, the pantographs were composed of torches which were guided by magnetic tracers, traveling automatically over templates or hand-operated over sketch drawings. In addition, the shear building area contained a motor-driven carriage, the flame planer, for splitting rectangular plate or trimming its ends and sides. The continuous furnace flame cutting area was equipped with two large heat treating ovens and a heat treating pit for stress-relieving, normalizing, and controlled cooling of flame-cut products. Finished plates were taken, respectively, by overhead crane or rail to the shipping building, where they were shipped, along with their sheared counterparts, in rail cars to national and local fabricators of steel plate.[31]

Armored plate and ship-shafting were produced from ingots at the DPC forge complex at Homestead. Located just south of the DPC open hearth plant, the complex's facilities consisted of heating, heat treating, forging, and machining equipment. Forging and furnace equipment were located in the forge shop, consisting of two adjacent, 107' wide x 644' long bays in a 376' wide building and lean-to, which also contained offices, lavatories, and locker rooms. Ingot and forged product transfer equipment included a 300-ton, floor-operated, hydro-electric overhead crane, a 200/25 ton E.O.T. crane, and a operator driven floor manipulator, all running parallel to the bays. In addition, a 125/25-ton E.O.T. crane, operating across the bays, serviced the building's 7000-ton forging press for maintenance purposes.

Incoming carbon and nickel-chromium alloy steel ingots, each weighing 175 or 250 tons, were heated to a forging temperature of 2300 degrees F in one of two 300-ton capacity, gas or oil-fired, 12' wide x 30' long, car-bottom forging furnaces, or in one of seven 500-ton capacity, gas or oil-fired, 15' wide x 49' long, car-bottom forging and treating furnaces. When ready for forging, an ingot was carried from the furnace to the 7000-ton four-column, hydraulic press.

Standing more than 43' above the floor, the Mesta Machine Company built press consisted of an hydraulically-operated crosshead, riding vertically over parallel sets of hollow columns or cylinders into an anchored cast base. As 3 regulating, horizontal pumps delivered 330 gallons of water per minute at a maximum pressure of 4500 psi into each cylinder, a ram plunged the crosshead, which carried the upper-half of an open-faced die, into an ingot resting upon the bottom-half of the die, at a rate of 3" per second. Spent water exited the cylinders by pipeline to one of four 2250 gallon accumulators, which stored it under air pressure, for reuse in the system.

The production of armored plate began with the 'cogging' operation, a series of low-pressure taps into the top, bottom, and sides of the alloy steel ingot for the removal of its flutes and ripples. This was followed by a series of high-pressure plunges, which reduced the ingot into an approximately 2' thick plate through repetitive blows that changed it, successively, to a octagonal, square, and rectangular shape while the hydro-electric crane and floor-manipulator turned it in tandem.

After pressing, the plate was delivered to one of several heat treating furnaces where its face was carburized by a mixture of coke-oven and natural gas. Burning the gases created carbon monoxide which reacted upon the face to form a hardened layer or carbide case, as the plate was heated to about 1650 degrees F for from 2 to 4 weeks. The case hardened plate was eventually strengthened by a second forging sequence at the press, before its high carbon face and low carbon underside were tempered by separate heat treating and quenching processes. Finished armor plate was shipped directly from the forge shop to Navy shipyards on the east coast.

Ship-shafting was forged from carbon ingots by the sequential operations of 'cogging'; 'upsetting' or the formation of an octagonal shape; and 'swaging' through the employment of cylindrically-shaped dies. The shafts were subsequently stress-relieved in heat-treatment furnaces and taken by rail to the adjacent machine shop where they were finished. The machine shop included 16 lathes ranging from 48" diameter x 30' long to 96" diameter x 80' long as well as a milling machine, drill press, and boring mill. Like their armor-plate counterparts, the shafts were delivered directly to east coast shipyards.[32]

Heat-treating of alloy rounds, produced at the Duquesne Works' 22-inch bar mill, was conducted at the nearby DPC alloy heat-treating plant, which was made-up of 5 gas-fired, car-bottom, batch furnaces from 25' to 36' long, a seven-chamber continuous electric furnace, and quenching, descaling, and straightening equipment. These were housed in an enclosed, steel-framed, corrugated metal, T-shaped structure consisting of a 69' wide x 396' long north-south bay and a 90' wide x 230' long transverse bay. A 25-ton E.O.T. transfer crane serviced each bay.

Heat-treating took place in the north-south bay, with the furnaces lined-up across the northern end. Bundles of steel rounds, up to 25' in length, were charged into the northern door of the rectangularly shaped car-bottom furnaces for annealing, normalizing, or quench and temper operations. Annealing, which made the steel more ductile, consisted of heating the bundle just above the critical temperature for grain refinement before slow cooling within the furnace until its grain-structure was transformed. Normalizing provided the rounds with a uniform grain-structure by heating the bundle 100 degrees F over its critical temperature for several hours before cooling in still air at ordinary temperatures. Quench and tempering involved using two car-bottom furnaces in tandem. The bundle was heated to between 50 degrees F and 120 degrees F above the critical temperature before rapidly cooling it in a liquid quenching medium -- oil, water, or brine. Although hardened, the quenched steel remained brittle, thereby requiring a tempering operation which relieved stresses within the grain-structure by heating to just below critical temperature and holding for a predetermined period of time, depending on the size of the bundle, before cooling at room temperature.

The seven-chamber, 209 kw continuous electric furnace was designed for quenching and tempering operations. Rounds in single layers were charged over a motor-powered, shaft-driven, time-regulated roller table which moved the stock through three consecutive chambers for heating and soaking. As the stock rolled out of the soaking chamber, it was run out onto a delivery table suspended over the quenching tank. After the rounds were immersed in the liquid medium, they were tempered in four succeeding chambers over a period of several hours before rolling onto a transverse loading rack.

The rounds were descaled by billet-peelers south of the furnace line before being taken, with their car-bottom counterparts, to the offset vertical rolls of one of four straightening presses located in the transverse bay, north of the furnaces. The rolls straightened the rounds in one pass before depositing them onto a storage bed where they were rebundled and taken by overhead crane to waiting rail cars at a spur along the western wall of the bay. Alloy rounds were shipped to national and local fabricators of shells and tubular products.[33]

Cast armor plate, produced by the McConway-Torley Corporation at Pittsburgh, was an essential component of the Army's tank building program. Beginning in 1942, the corporation made virtually all types of armor castings for the M-5 or U. S. Grant line of tanks. Built at the midwestern plants of the General Motors Corporation's Cadillac Division, the Grant tanks proved superior to their German counterparts, being primarily responsible for driving General Erwin Rommel's armored tank divisions out of Africa.[34]

The castings were produced at McConway-Torley facilities and at a DPC heat-treating and shipping plant located on an adjacent 300' wide x 800' long lot. The main building of the privately-owned facilities was divided into three bays, 688' long x 66', 63', and 18' wide. The two largest bays, known respectively as the heavy and medium floor, contained the furnace equipment which consisted of two acid open hearth furnaces, one 18 and one 20 ton, and a 4 ½ ton electric furnace. The smallest bay was devoted to the handling and transfer of sand. A fourth bay, approximately 200' long, ran parallel to the main bays and was used as a stock house for steel scrap, iron ore, and other raw materials. Several overhead cranes and stiff-leg charging machines transferred materials from the stock house to the furnaces.

Molten steel was cast from ladles into one of eight rollover moulding machines, located on the heavy floor. The machines, which were equipped with flask sand feeders, delivered closed moulds to the heavy floor for pouring by roller conveyor. Solidified castings were shaken out of their moulds by the use of vibrating screens. In addition, the main building contained a core room, pattern shop, and laboratory. Castings were case-hardened or carburized at the DPC plant before being shipped to Cadillac.[35]

Rolled carbon steel plate was essential for the landing craft production program of the United States Navy, amounting to the fabrication of 34,818 landing vessels of all types nationwide from 1941 to 1944. The early expulsion of the Allied Nations from the European continent and Far Eastern Pacific rim made the use of large and small beach landing craft indispensable for Allied amphibious invasions because of the inadvisability of invading heavily fortified port cities. As a result, the Navy conducted two large procurement programs, generally geared to the invasions of North Africa in November of 1942 and Normandy on June 6, 1944.

Of the 22 landing craft models produced, the LST was among the most important, accounting for more than 50% of the total displacement tonnage, or 1,447,000 out of 2,735,000 tons. The 328' long, shallow draft, welded, ocean going vessel was capable of unloading large numbers of tanks, heavy artillery, trucks, and troops onto Axis controlled beaches by the application of a loading ramp which opened onto the beach-head through the doors of its rectangularly shaped bow. After unloading was complete, the 1,490 ton craft returned to the sea through the use of anchors and winches.[36]

Over 20% of the 1,038 LST's constructed during the war were fabricated at two newly built, Navy-owned shipyards, adjacent to the Ohio River properties of the their respective management firms -- The Dravo Corporation and the American Bridge Company. Each yard cost more than $10,000,000 to build. The facilities at American Bridge consisted of 10 ship berths, arranged in two vertical parallel rows, a launching skidways, and a fitting-out dock, in addition to 35 buildings where prefabrication of ship sections took place. The new yard at Dravo complemented a company-owned, pre-existing yard and contained a vertical row of 4 ship berths, a launching skidways, fitting-out dock, and several prefabricating shops.

Dravo's contribution to the LST program extended considerably beyond the construction of ships. Because of its pioneering role in the development of assembly-line techniques for the fabrication of steel barges in the 1930s and submarine chasers in 1941, Dravo was designated the lead yard for the Navy's inland river LST program, which produced 68% of the total number of units. As a result, the corporation oversaw the installation and operation of its assembly-line procedures at 4 other participating yards along the Ohio and Mississippi Rivers.

The central elements of Dravo's assembly-line system focused on the development of prefabrication techniques for hulls and decks and on methods for transferring ship sections progressively along the craft assembly berths to the launching skidways. The LST were divided into several large sections. At Dravo, the straight sections between the bilge and gunwale were constructed by subcontractors, while the molded bow and stern sections were fabricated in-house. All craft sections at American Bridge were produced on-site.

Ship sections were constructed with the aid of structural jigs which allowed the keel sections to be fabricated upside-down, thereby allowing the steel plates to be welded together from the downhand position. Revolutionary, in terms of standard shipbuilding practice, exclusive downhand welding increased the available pool of welders meeting Navy requirements by 400%, while decreasing welding-time by 25%.

Finished sections were fitted onto flat rail cars and taken to the vertical line of ship assembly berths, which were arranged so that the vessel could be welded together in layers or tiers. The sections were transferred from the cars to their respective berths by large whirler and gantry cranes. Keel sections were overturned and placed into the keel-laying berth by a whirler crane using a special jig consisting of a structural beam from which steel wire loops were each attached to a separate block and tackle for the maintenance of the section's center of gravity as it was being revolved. Completed tiers were moved over rail from berth to berth and finally to the launching skidways by a horizontal line of transfer buggies upon which the layers, in their various stages of development, were placed. After launching, the LST's were taken a short distance to the fitting-out dock where the ship's diesel propulsion unit, system of utilities, deck ramps, ventilators, galley equipment, and other assorted items were installed. Completed vessels proceeded down the Ohio and Mississippi Rivers to New Orleans where they disembarked to one of the several theaters of war.[37]

Chromium-nickel-molybdenum plates, rolled at the Jessup Steel Company, were fabricated into hollow, blade-adjustable airplane propellers at the Curtiss-Wright plant in Beaver Falls. Constructed in 1941, the Curtiss-Wright facility was part of a $4 billion nationwide expansion which increased aircraft productive capacity by 2000% between 1940 and 1944. The plant employed slightly more than 4000 workers, skilled in the forging, machining, welding, and heat treating operations needed to manufacture the propellers, which were used on several different aircraft models, including the B-26 and B-32 bombers.

Known for their strength and superior resistance to erosion, the propellers were formed from two plates into a thrust and camber section by a series of forging and edging operations at the plant's 2000-ton presses and milling machines. After the beveled edges of the sections were fused together by atomic-hydrogen arc welding, each propeller was heated to 1800 degrees F. before its shank was swaged under 27-tons of pressure and welded together. Next the blade was upset at the press, increasing its thickness while decreasing its length. This was followed by brazing whereby a copper fillet was welded on the inside edges of the blade to reduce stress caused by in-flight vibrations.

In order to impart the toughness and durability required of the blade, it was subjected to normalizing, and quench and tempering. Normalizing consisted of heating it to 1700 degrees F. for one hour before cooling it in a roto-cooler for 90 minutes. It was then reheated and placed into a forging pressure die where its final contours were shaped by the application of 1300 psi while simultaneous quenching by water spray took place. The blade was tempered in a vertical electric furnace for 1 ½ hours at 1100 degrees F. After cooling in still air, the blades were balanced, polished, and lacquered before being shipped to the company's main assembly plant in Clifton, New Jersey where they were attached to engine mounts, which each included a small motor for adjusting the blade angle of the propellers to meet in-flight conditions.[38]

Carbon and alloy steel rounds, and seamless tubes of predetermined sizes were fabricated at the Christy Park Works into shell-forgings and aerial bomb-casings respectively by the Witter and Spinning processes. Developed exclusively at Christy Park, each process was capable of producing twice as many pieces per worker hour than previously accomplished under other methods.

At the beginning of the Witter process, round bars were pickled (i.e. dropped into an acid bath) to reveal possible surface defects which were subsequently removed by hand chipping or scarfing. The bars were then cut into slugs of predetermined lengths by a circular saw before being placed in a rotary hearth furnace where they were heated to a forging temperature of 2250 degrees F. After removal of furnace scale by water-spray, an hydraulic piercing press was used to create a cavity or pocket in each slug.

Pierced slugs were individually placed in the Assel Mill, consisting of an hydraulically-pushed contoured mandrel and three diagonal rolls, formed to the shape of the shell casing. The mandrel was fitted into the pocket of the slug and pushed between the rolls for cross-rolling which reduced the slug's wall thickness while increasing its length. The newly formed cup, with the mandrel still engaged, was then pushed through a ring or roller-sizing die to meet desired tolerances. Finished shell forgings were delivered to local assembly plants for final processing.

The Spinning process for aerial bomb-casings, originally developed at the works' between 1936 and 1939, replaced the Pierce and Draw process. Under the old method, hot seamless tubes were passed through a series of rings contoured to the shape of the bomb-casings. The Spinning process, which eliminated the considerable amount of machining needed after the Pierce and Draw method had been completed, consisted of several small heating furnaces, and nose and tail spinning machines.

Seamless tubes, 8" O.D. x 7/32" thick x 31 3/8" long for 100 lb. bombs and 10 3/4" O.D. x 5/16" thick x 38" long for 200 lb. bombs, were individually placed with one end in the furnace and heated to spinning temperature. The cold end of the tube was then anchored inside of the chuck of the nose spinning machine, leaving its exposed hot end to rest up against a cylindrical, 14" diameter, cam-controlled roller tool, which was attached to the machine's compound head by a swinging-arm. The compound head rested upon a pivot, consisting of a plate connected by pin to a lateral moving table mounted on ways.

During the nose spinning operation, the chuck was revolved by a belt-driven shaft connected to the machine's electric motor, while the roller tool, moving radially, closed the nose of the casing in tandem with the action of the pivot, which swung the arm in an arc, as the table moved on its ways toward or away from the chuck. The swinging-arm, pivot, and table were hydraulically operated. Nose-spun tubes proceeded over a cooling conveyor to the furnaces where their open ends were reheated prior to their noses being individually placed into the chuck of the tail spinning machine. The tail was formed by a doubled tapered cylindrical roller tool in the same manner as the nose.[39]

Artillery gun tubes and gun carriages were forged, cast, and machined at the Mesta Machine Company, a worldwide leading designer and manufacturer of production equipment for steel mills before the war. Established in 1898, the company served a dual role during the war: the production of its traditional line of equipment for the steel expansion programs of the United States and its allies, and the manufacture of ordnance for the War and Navy Departments. Included among its traditional products were blooming, structural, and merchant mills for the Kaiser Steel Company at Fontana, California; a plate mill for the DPC Columbia Steel Company at Geneva, Utah; the 160" plate mill and 7000-ton forging press for the DPC facilities at Homestead; a bar mill for the DPC plant at the Republic Steel Company, South Chicago; two 10,000-ton forging presses for the Soviet Union through Lend-Lease; a blooming mill for the National Steel Company of Brazil; and a wide assortment of massive cut gear rings and racks. For the War and Navy Departments, the company manufactured 155mm gun tubes and breech housings, 16" coastal defense guns and carriages, ship shafts and turbine rotors for cruisers and aircraft carriers, and 'Little David', a top secret, experimental 36" cannon. In addition, Mesta produced large-scale magnesium and aluminum extrusion presses for the aircraft industry and pioneered in the design and construction of a 4-high mill for rolling wide aluminum sheets.

In order to meet the requirements of expanded war-time production, the company spent $5.33 million of its own capital and managed a $2.56 million Navy financed expansion to augment its production facilities, which consisted of separate iron, roll, and steel foundries, a heat treating department, forging department, machine shop, erecting shop, and roll turning, gear moulding, and gear cutting departments on the eve of European hostilities. The privately financed expansion included a 6000-ton hydraulic forge press, several heat treating furnaces, two buildings for housing company-owned finishing equipment, and one building for housing government-owned 155mm gun finishing equipment. The Navy financed expansion entailed the construction of a forging plant on property adjacent to Mesta. The 155mm gun finishing machinery, moreover, became an important test case of the tax-exempt status of federally-owned property when Allegheny County assessed the company $5,137 in taxes for the equipment. Federal and company opposition to the assessment eventually resulted in a United States Supreme Court decision upholding the tax-exempt status in January of 1944.

Among Mesta's numerous war-time manufacturing accomplishments, which resulted in 7 Army/Navy E awards for excellence, was the production of 2,443 155mm gun tubes and breech housings or more than half those produced across the country. Beginning with the teeming of a 34" diameter ingot from an open hearth furnace in the steel foundry, the process for making the tubes and breech housings involved 85 steps. Included among them for the tubes, were forging the ingot into the shape of a gun barrel on the 6000-ton press, sawing the tube to length, heat treating it, straightening it, finishing its surface on a lathe, drilling and boring it on an horizontal boring machine, rifling it, and machining slots for the breech housing hinge lugs. Breech housings were made from two parts, the breech ring and breech block, out of separate boring, slotting, threading, and milling machine operations. The guns were shipped after the tubes, breech rings, and breech blocks were fitted together.[40]

In addition to being an important center for the production of steel products for military use, the district played a major role in the nation's electrolytic tin plate and synthetic rubber programs. Developed at Pittsburgh by the United States Steel

Corporation on an experimental basis in the mid-1930s, the process for making electrolytic tin plate became an integral part of a nationwide effort to make up for the loss of Far Eastern tin supplies, which also included the construction of a tin smelter in Texas for reducing Bolivian ores and voluntary tin scrap drives.

Electrolytic tinning replaced the hot dip method for making tin plate whereby a tin coating was applied to strip steel by dipping it into a bath of molten tin. By contrast, electrolytic tin plate was produced by running the strip steel through a plating tank consisting of a phenolsulphonic-acid, electrolyte solution maintained at 120 degrees F. and several tin anodes, 3" x 2" in cross-section and 6' long. Electric current, measuring 45,000 amperes at 16 volts, was passed from the anodes through the solution to and up the strip to metal deflector rolls which acted as the negative contact of the system. By this method, the tin was deposited into the solution and onto the strip from the anodes. In all, the new process represented a 14% savings of tin over the hot dip method and resulted in the construction of 26 electrolytic tin plate lines across the country.[41]

The Pittsburgh district was, finally, a significant region for the nation's synthetic rubber program, particularly with respect to the design and construction of production facilities across the country and in the manufacture of butadiene and styrene. In the field of design and construction, the United States Government commissioned the Blaw Knox Company at Blaw Knox to handle all engineering and design work in connection with the Buna-S synthetic rubber program, including the butadiene and styrene production facilities at Kobuta in Beaver County. The company also procured a major part of the processing equipment for the program, which consisted mostly of high pressure, stainless steel vessels. In addition, it erected the co-polymer plants managed by the United States Rubber Company at Institute, West Virginia and Naugatuck, Connecticut; the Firestone Tire and Rubber Company at Baton Rouge and Lake Charles, Louisiana; and the B. F. Goodrich Company at Louisville, Kentucky.

The plant at Kobuta was constructed in 1943 and managed by the Koppers Company, headquartered in Pittsburgh. It produced butadiene and styrene, essential raw materials for making synthetic rubber, by cracking them from ethyl alcohol through catalytic conversion. The raw materials were then shipped to polymerization plants at Institute or Louisville where the final product was made. Although, moreover, the alcohol based program for producing butadiene comprised just 3 plants nationwide and was initially considered to be only a minor supplement to the petroleum based method for procuring the raw material, it supplied 75% of all butadiene made in the country during 1944.[42]

The increase of industrial production for military needs represented a significant rise in the annual value of products manufactured in the district between 1939 and 1944. Measuring $1.436 billion in 1939, the value of manufactured products grew to $1.826 billion in 1940, $2.622 billion in 1941, $3.164 billion in 1942, $3.503 billion in 1943, and $3.637 billion in 1944. The region's manufacturing workforce, in turn, increased by 66% during the period, rising from 204,791 to 342,038. The participation of women in the industrial workforce, moreover, increased by 153%, rising from 22,976 to 58,343.[43]

Because a large percentage of the pre-war manufacturing workforce entered the military during the period, thus creating a significant demand for labor across the spectrum of skills, the number of new workers entering the labor force was actually much greater than the total increase would indicate. As a result, area firms were faced with the task of imparting the required skills for industrial work on a vast number of untrained workers as well as upgrading the skills of seasoned workers remaining behind. In order to accomplish this, they employed one or all aspects of the federally-sponsored public/private job training program -- training-within-industry, vocational school courses, and engineering school courses.

On-site skill development or training-within-industry was the primary component of the job training programs of several large local firms. The Dravo Corporation, for example, established more than a dozen on-site programs to train its expanded workforce, which increased by 2900% to 14,196 during the war, in such skills as welding, pipefitting, electrical work, shipfitting, rigging, blueprint reading, and foremanship among others. Likewise, the Mesta Machine Company exclusively employed in-plant programs to train the more than 1000 additional workers it hired during the period in the intricacies of machine tool operations.

Federally-financed training through established vocational schools met the hiring needs of many smaller companies which could not afford to set-up their own job training programs. By September of 1942, 3900 students in the region were attending vocational school classes in machine tool operation, electric welding, and electric maintenance and repair among others.[44]

Intensive training for engineers under the federally-funded United States Engineering Defense Training Program was conducted at the district's three main engineering colleges -- The University of Pittsburgh, Carnegie Institute of Technology, and the branch campuses of the Pennsylvania State College at McKeesport and New Kensington. Designed primarily to upgrade the skills of seasoned industrial workers possessing a high school diploma for engineering, scientific, and managerial work roles, the program attracted over 2900 students in 1942 by offering courses in engineering drafting, machine design, metallurgical inspection, metallurgical engineering, production engineering, production supervision, and mining engineering. The courses, which ran from 12 to 24 weeks in length, were generally offered in the evening so that students could attend them after their workday was over.[45]

Several area firms utilized all three aspects of public/private job training. Included among these was the Carnegie-Illinois Steel Company, which employed 41,370 workers at 6 steel mills during the peak of war-time production or just over 1/3 of all workers employed in the local iron and steel industry. In pursuit of a job training philosophy which emphasized specificity, the company utilized a hierarchical approach for instructing each new worker to do one specific job by using its foremen as teachers. In order, furthermore, to fill technical and supervisory positions created by the expansion of its facilities at Homestead, Braddock, and Duquesne, the company gave consideration to employees who upgraded their skills through college courses taken in the United States Engineering Defense Program.

The job training program of Carnegie-Illinois began, in practice, with the instruction of its foremen in the proper method of teaching beginning workers their new tasks. The foremen, in turn, were responsible for training new skilled, semi-skilled, and unskilled production workers in an on the job manner. Among the occupations receiving this type of training were ore-bridge operators, stove-tenders, larrymen, and larrymen helpers at blast furnaces; charging-machine operators, nozzle setters, and door operators at open hearth furnaces; shearmen, hand chippers, and buggy operators at blooming and slab mills; and marking-machine operators, screwmen, transfer-table operators and shearmen's helpers at plate mills.

Job training in such skilled maintenance positions as machinists, electricians, millwrights, and boilermakers had traditionally been conducted through the company's 4 year apprentice program before the war. The rapid turnover of personnel caused by the manpower requirements of the military, however, made it impossible to wait 4 years for a trained man. As a result, supervisors were relied upon to train workers in the various maintenance skills both on the job and within the vocational classroom setting. Because many of the instructors for the numerous federally-financed vocational courses offered at local public schools were also Carnegie-Illinois foremen, it became practical to arrange for a worker to gain functional experience on the job while learning the theory of that job in the evening from his or her daytime supervisor.

Training, finally, for such supervisory and technical positions as blowers and blowing engineers at blast furnaces, melters at open hearth furnaces, and rollers and rolling engineers at slab and plate mills were available through federally-funded engineering school courses. Particularly important in this regard were courses in metallurgical inspection, metallurgical engineering, production engineering, and production supervision.[46]

Unlike many other major war-production centers, the Pittsburgh district did not draw a large number of migrants from across the country. Between the start of full scale war-production in October of 1940 and the eve of American participation in the world-wide hostilities, Allegheny County attracted 17,500 persons, including 8,700 families to help fill an estimated 50,000 additional jobs district wide, 20,000 of which were considered to be beyond the reach of the region's labor market. Relatively light by national standards, the county's in-migration equaled ½ as many as Baltimore, Maryland, 1/3 as many as Houston, Texas, 1/4 as many as Los Angeles, California, and 1/7 as many as Seattle, Washington. Less than 10% of the migrants, moreover, traveled into the county from more than 500 miles, as communities within a 120 mile radius of the city of Pittsburgh made up 68% of the total. Neighboring communities in Pennsylvania contributed 50% of the grand total with migrants from nearby Ohio and West Virginia adding 10% and 6% respectively.

In succeeding years, with the exception of a one-time conscious importation of 835 African-Americans from the Washington, D. C. area in 1943 by the Carnegie-Illinois Steel Company and the national recruitment efforts of the Dravo Corporation, migrants into the district's two largest industrial centers -- Allegheny and Beaver Counties -- continued to come primarily from outlying communities in the tri-state area. Most of these, moreover, commuted to their jobs, largely by private vehicles before severe gasoline rationing in 1943 and by expanded public bus and train service afterward.[47]

Although light in comparison with the national experience, in-migration levels were, nevertheless, too much of a burden for the region's housing stock, which averaged, in terms of gross habitable dwelling vacancies, just 1.4% district wide in August of 1941. Of the 2,300 habitable rental family units and 6,000 single rooms available at that time, half were located within the city of Pittsburgh. A region wide lag in anticipated additional hires, equaling just 26,722 new jobs during 1941, compounded the burden. Fully 9% of Allegheny County in-migrants, for example, were unemployed at the end of the year. The relatively high percentage of in-migrant unemployment reinforced the traditionally conservative speculative investment policy of the local private housing industry which failed to adequately address the new needs. As a result, most in-migrant families within the county doubled up with existing families, lived in hotels, or resided at tourist or trailer camps. Conditions in Beaver County were no better. By June of 1941, the county's vacancy rate of habitable dwellings fell to 0.11%, while 2630 local units, 792 of which contained doubled-up families, were overcrowded.[48]

The resulting community sense of crisis energized local Homes Registration Offices (H.R.O.) in the spring of 1941. Authorized by the Division of Defense Housing Coordination (D.D.H.C.), local registration offices in Allegheny County were led respectively by the Steel Workers Organizing Committee (S.W.O.C.), which provided substantial information on local housing conditions before the HRO's were organized; local housing authorities; and local housing committees composed of civic-minded community planning professionals concerned with the promotion of additional low-income housing. Their combined documentation efforts confirmed a coinciding WPA housing survey showing 38% of Allegheny County dwellings to be substandard. Of the 32,000 houses surveyed, 3% were unfit for use, 20% had no toilets, 33% no bath, 3% overcrowded, and 2% were doubled-up. As a result, the DDHC, in June of 1941, authorized Curtiss Summers to conduct a survey of housing conditions in the region. After speaking with local real estate agents, representatives of the local construction industry, and local housing authority officials, Summers submitted a report which became the basis of a mandated region wide allocation of 5000 federally-funded family housing units. Put under the general direction of Regional Defense Housing Administrator, Brynjolf Jakos Hovde, who was also director of the Housing Authority of the City of Pittsburgh (HACP), the war-housing program ultimately added 5,290 federally-financed permanent family units to the district, with 4,240 built in Allegheny County, 1800 in Beaver County, and 240 in Westmoreland County, In addition, the region was the beneficiary of 580 temporary war-housing units and more than 1,000 dormitory rooms for single workers.

The permanent units were divided into 29 one, two, and three bedroom communities region wide, 16 of which were located in Allegheny County, 12 in Beaver County, and one in Westmoreland County. Of the total, 25 were initiated under the auspices of the FWA in 1941. The others were initiated after the FPHA was organized in 1942.[49] Constructed, for the most part, to take advantage of the vistas offered by the region's hilly terrain, their completion was variably beset by several obstacles, including time constraints, landscaping difficulties, material shortages, and fear that the presence of federally-funded housing communities would devalue surrounding private property.

The variable development of Glen-Hazel Heights in Pittsburgh, Munhall-Homesteads, and Aluminum City Terrace in New Kensington, Westmoreland County provides excellent evidence of the war-time difficulties experienced across the district at federally-funded housing sites. The construction of Glen-Hazel Heights, located above the by-product coke works of the Jones and Laughlin Steel Corporation in the nearby Pittsburgh community of Hazelwood, was financed by the FWA through the USHA for management by the HCAP. Offering a vista across the Monongahela River overlooking the Homestead Steel Works, the community consisted of 999 one, two, and three bedroom family units contained within 104 multi-family, 2-story, wood clapboard exterior with asbestos shingles, hipped roof structures erected barracks style and set upon an upper and lower hillside tier. Also included were an administration building and a commercial center. A community center was added in 1943.

Erected between April of 1941 and July of 1942, the construction of the residential community encountered several problems resulting from a lack of quality control in the areas of site selection, landscaping, and building completion within the context of time constraints caused by the demolition of Homestead's working-class second ward neighborhoods. Located downriver from the main pre-war complex of the Homestead Works and upriver from the 100-inch plate mill (constructed in 1937), the waterside community made way for the DPC facilities at Homestead. Because of the need to quickly provide housing for a portion of the 2,370 families displaced by the demolition to allow for construction of the critical plant expansion, the DDHC designated the transfer of 200 uprooted Homestead families to the Glen-Hazel community in December of 1941.

Site selection, given strict time constraints, was extremely poor considering the local authority's inability to ensure the meticulous site survey needed to produce a sound building location plan for the prevention of damage from an abandoned mine laying beneath the planned location. Approximately $25,000 was required to repair the foundation of a residential building threatened by mine subsidence. Even more serious, the failure of building contractors to provide gutters for the multi-family dwellings resulted in shrinkage of wooden window framing and, in turn, to the detachment of sills and moldings which allowed rain to enter through the walls causing both exterior and interior warpage at floors and walls. To add insult to injury, many war-production families regularly faced large pools of stagnant water around their buildings due to improper landscaping techniques for tiered development. Residential families responded to the deteriorating conditions by organizing a tenants group, which invited representatives of SWOC to intervene in negotiations with HACP board members over proposed improvements.

Over the war period, the HACP requested nearly a million dollars to carry out work on repair projects. Two major improvement projects was undertaken in 1943 and 1944 involving landscaping and gutter additions as well as the addition of the community building. Despite the large sums spent on war-time repairs, which brought the total expense of the project to nearly $5,000,000, the cost per family unit did not exceed the limits originally imposed by congress.

Munhall-Homesteads, another center for displaced second ward families, was located in a hollow overlooked by a substantial private community. The federally-financed community was made of brick construction with gable roofs and included 397 family units located within several types of semi-detached structures.

Compounding strict time constraints caused by federal pressure to relocate uprooted Homestead families, was resistance to Munhall-Homesteads' existence in the boroughs of West Homestead and Munhall. Neither borough contributed to the cost of installing a sewer line into the new community, fearing, in part, that the new addition would eventually force expensive waste disposal modernization costs on them. In addition, Munhall initially refused to provide police and fire protection to the defense community; funds for the upkeep of paved roads within the development; and garbage collection. The latter refusal ultimately caused animosity between war-production families and local natives over incidents involving garbage dumping on private residential property by the newcomers. Discord between federal representatives and local officials grudgingly subsided after the state legislature granted an exemption to the defense community which allowed it to dump untreated waste into the Monongahela River. A modicum of cooperation between the newcomers and the native population was finally achieved after the December 7th attack on Pearl Harbor.

Authorized in May of 1941 to be constructed under the management of the Allegheny County Housing Authority (ACHA), Munhall-Homesteads cost $1,972,000 to build. The community accepted its first 26 families into one of five standard multiroom units in November of 1941. At the time of their arrival, construction of the community infrastructure was still unfinished with often muddy, unpaved roads dominating the landscape. Four commercial stores and a community center helped serve the provisioning and recreation needs of the residents.[50]

The war-time development of Aluminum City Terrace (ACT) shared similarities and differences with its counterparts in Munhall and Glen-Hazel. Like Munhall-Homesteads, Aluminum City Terrace was the object of intense antagonism from surrounding economically well-off private residential property owners. Unlike the Munhall and Glen-Hazel communities, which attracted little negative attention to their traditional architectural styles, the New Kensington project's unique style was a primary focus of local resistance.

Designed by world renowned architects, Walter Gropius and Marcel Breüer, ACT reflected the ultra-utilitarian International style of architecture. Its location on a hilly site, 2 ½ miles from New Kensington, resulted in several delays due to landscaping problems caused by the terrain. As a result, it took 14 months to complete from the time of its authorization in May of 1941. The community accommodated 240 residential families within a multi- and semi-detached dwelling framework composed of 150, slightly sloped roof buildings, including 60 three-bedroom units, 50 two-bedroom units, 40 single bedroom units, and an administration building. Space within the residential units, consisting at two bedroom dwellings of a 170 sq. ft. living room, 100 sq. ft. dining/kitchen area, 150 sq. ft. master bedrooms, and 115 sq. ft. children bedrooms, met federal living standards. A community center was added near the end of the war.

Designed to create an informal relationship with the surrounding terrain, construction of the International style residences was accomplished through the utilization of pre-fabrication techniques. In this manner, building panel frames were erected on jig tables and arranged in stacks before being fitted together on platforms composed of ground floor joists and flooring. Stud panels doubled at the end to become 4-inch posts. The buildings were faced with horizontal timber sheathing, building paper, brick and cedar wood siding, fixed vertically. Included among the unit's distinctive features were alternate side walls made of brick and cedar panels and the installation of large glass wall panels equipped with slatted wood sunshades for the manipulation of winter and summer sun patterns to maximize relief from excessive heat and low winter levels of sunlight.

Although the Cedar wood and glass block materials used in the construction of the defense community met federal emergency standards for the substitution of scarce building materials, they initially offended the sensibilities of native conservative housing tastes, leading to the widespread adoption of the term 'chicken coops' to describe housing units in the development. Traditional tastes combined with the unexpected cancellation of a proposed plant expansion at the nearby production facility of ALCOA, to create an low initial demand from potential occupants, resulting in only a 17.5% occupancy rate in August of 1942. By February of 1943, less than half of the homes were occupied before finally filling up in 1944.[51]

Despite the federally funded district-wide expansion, housing conditions in the region continued to be tight throughout the war. In October of 1944, federal officials, citing a shortage of 8500 rental dwellings, termed the situation desperate because of returning servicemen and an upsurge in home buying.[52]

<u>Post-War Development</u>

During the reconversion from military to civilian production, the district's federally-owned industrial facilities were quickly purchased by their related management firms, substantially increasing industrial capacity. Employment gains within the region's manufacturing sector declined by 1946 to 48% above 1939 totals. Significant additional steelmaking capacity was constructed through the acquisition of 32 acres of Pittsburgh southside property by the local Urban Redevelopment Authority (URA) in 1949 for the benefit of J & L which added an eleven furnace open hearth steelmaking plant on the land. Two further expansions at the J & L southside works in 1952 were the beneficiary of 87 total acres purchased under URA auspices.

The character of the district's industrial war-time expansion blended easily with the existing industrial plant. Over the post-war years, the formerly government-owned facilities, as demonstrated by the activities of the Carnegie-Illinois Steel Company, provided the bulk of the region's manufacturing output. The company's former DPC facilities operated throughout the post-war period until the economic depression in steelmaking during the late 1970s and early 1980s. At the Homestead Works, the former DPC expansion became the primary agent of post-war production, outlasting all its pre-war counterparts save the 48-inch universal plate mill (installed in 1899) and Press Shop No. 1 (originally constructed in 1891). The only major company-financed expansions took place at the Duquesne Works from 1959 to 1964 and at the Edgar Thomson Works (E.T.) in 1972. The expansion at Duquesne encompassed the addition of a primary rolling mill, a blast furnace, and a basic oxygen steelmaking shop (BOP). A BOP shop was also added at E.T. The company's low equipment replacement rate mirrored conditions in steel locally, resulting in the loss of ground to other steel producing regions more involved in post-war modernization. The district, as a result, lost its national leadership in overall production which dropped gradually from 25% in 1950 to 17.5% in 1980, before plummeting to 11.8% in 1985.

Because the character of the war-time industrial expansion reinforced the traditional producer goods orientation of regional production, the district continued to suffer more than other areas of the country in economic downturns. At the trough of a national recession in 1961, for example, the region's unemployment rate stood at 10.7% as compared to 6.5% nationwide. The national rate fell to 5.4% in the following year while the district rate hovered at 9.4%. Compounding the problem, manufacturing jobs gradually declined from the district wide high of 293,000 in 1966. By 1979, the region had lost 67,000 producer durable production jobs before falling precipitously to 125,000 total manufacturing jobs in 1988.

The large producer goods sector in iron and steel production shaped, in large part, the pattern of labor-management negotiations in the post-war period, particularly with respect to the Pittsburgh based efforts of the United Steel Workers of America (USWA) to provide a guaranteed annual wage for union workers in the industry. As a result of the union concern with the issue of wage security, the USWA gained ground with the negotiated Supplementary Unemployment Benefit (SUB) package in 1955. Under the plan, the company supplemented the income of its unemployed workforce by adding SUB pay to unemployment benefits. In this manner, idled workers received about 90% of normal take home pay during periods of layoffs.[53]

The disposition of federally-owned residential communities, originally intended to be sold primarily to private realtors or the local housing authorities for use as subsidized low-rent housing, began slowly during the reconversion period and was not completed until the mid-1950s, due to delays caused by the reorganization of federal housing agencies within the Federal Housing Admininistration in 1947 and the advent of the Korean War. The arrangements of a mutual home ownership plan, inaugurated in 1941 by the FWA, and intended to provide for only a small portion of housing needs during the war, however, attracted strong interest both within the defense communities themselves and among local veterans groups during the post-war period. Under the plan, defense housing residents had been given the right to form a non-profit mutual home ownership association for the attainment of a lifetime lease on the property. As a result, the the National Housing Agency developed a cooperative housing plan based, to a large extent, on the early model. In return for a 5% downpayment by the mutual home ownership group, the FPHA financed the purchase of the site at a 3.5% interest rate over 40 years.[54]

An early federal attempt to sell selected communities in 1947, attracted the attention of residents in and around Aluminum City Terrace, which became one of the earliest communities to take advantage of the new option by expending a $56,000 downpayment to purchase the community for $560,536. Residents of ACT expressed satisfaction with their living arrangements after becoming accustomed to the conditions offered by the development's unique design. As a result of their contentment and, perhaps, also out of a strong sense of community identification caused by the widespread local criticism of the development, a cooperative organization was formed among ACT residents and non-resident veterans in 1947. The group purchased the community in 1948. After the mortgage was paid in 1965, a $350,000 renovation project was authorized by the resident shareholders for the replacement of cedar panels and wooden sunshades by brick and aluminum counterparts respectively. Today the community remains substantial with long waiting lists for available vacancies because of a low monthly expense rate of not more than $185 after a one-time membership fee of $3,500.

The successful cooperative venture at Aluminum City Terrace was emulated by other federal war-time housing community residents within the district. By the mid-1950s, in quick succession, the communities of Munhall-Homesteads, Riverview Homes and Monongahela Heights in West Mifflin, North Braddock Heights in North Braddock, and Electric Heights in Turtle Creek joined the ranks of cooperative-ownership.

Glen Hazel Heights, earmarked for sale to the HACP from its inception, was not finally sold to the authority until 1953. After the National Housing Act of 1950 codified a preference for veteran membership in the make-up of mutual home ownership groups, moreover, an attempt was made by a local Veterans of Foreign Wars Lodge to cooperatively acquire the property. The effort failed largely because it lacked the support of the development's residents who were well aware of its shoddy history of quality construction. At the time of the community's demolition in the 1970s, it was reported that toilets would not flush within the rat infested buildings and that stagnant pools of water lay all around the complex.

A third community, Mooncrest in Moon Township, Allegheny County, exemplified federal sale to private realtors. Made of brick construction, the 106 residential structures within the complex contained 400 semi-detached family dwellings of six standard types. After the war, Mooncrest, which was originally built to house war-production workers at the Dravo Corporation, was operated by the United States Air Force for the benefit of families of enlisted personnel stationed at the Moon Township Air Base. In 1955, over the strong protest of the resident military families, who were prohibited by Air Force regulations from entering into cooperatives, the development was sold to several private realtors, including the Cleveland, Ohio firm of Garfield and Gumprecht which purchased 28 buildings containing 107 dwelling units for $375,150 in 1957.

Among the three methods of government disposal, cooperative ownership proved to be the most popular in the district, accounting for the sale of the majority of permanent communities. While nearly all the mutually-owned communities remain substantially intact today, there are no war housing units left in the private sector and only one federally-subsidized low-rent community.[55]

Conclusion

The war-time experience of the Pittsburgh district was both similar to and different from the national experience. Like other comparably large industrial regions, the Pittsburgh district benefitted greatly from the federally-financed industrial plant expansion. In terms of jobs expansion, the district outpaced the national average, rising to 66% above 1939 totals as compared to slightly more than 50% nationwide. Women's participation in the region's manufacturing labor force, which rose by 153% above 1939 totals, lagged behind the national average of 460%. The predominance of iron and steel production in the region probably accounts for some of the discrepancy. Although women found work at area steel mills in significant numbers, they were excluded from most higher paying production jobs.[56]

Although migration into the region was slight compared to national standards, the district was one of the largest beneficiaries of federally-funded housing in the country. Due in large part to the substandard condition of the region's housing stock, which could not accomodate even the relatively small amount of in-migration, the area also benefitted from the opportunism of local housing authority officials, union leaders, company officials, and civic-minded professionals who took advantage of the opportunity offered by the federal housing effort to lobby government officials successfully for more family dwellings. As a result, thousands of area residents today enjoy a comfortable existence through the low-cost cooperative-ownership experience, often by overcoming initial class-based discord to their presence.

The impact of the war on the subsequent development of the regional economy failed to reach the expectations offered by the war-time experience. The creation of thousands of war-time jobs, many with attendant job-training programs, restored in great measure the lost dignity suffered by the working-class community during the great depression. Job-related dignity was recognized and expressed by skilled and unskilled workers alike as well as their peers. Robert Ripple, who began work in 1936 for a local supplier of refractory bricks to the steel industry, the Salina General Refractory Company in Westmoreland County, took pride in his job as a wheelbarrow man because not everyone could learn to balance and maneuver 400 or 500 pound loads of brick. Advancing to the position of kiln fireman in the post-war period, Ripple proudly testified in a recent interview, that there was no substitute for an experienced fireman because no two gas-fired kilns acted alike. Ray Sprigle, a staff writer for the Pittsburgh Post-Gazette during the war, demonstrated the admiration which the general public held for highly skilled work in an article which marveled at the practical skill of open hearth melters, who were able to judge the carbon content of critically important armor steel heats within a one percent tolerance by observing the crystalline structure of a molten steel sample just brought from the furnace as it solidified in the sample holder.[57]

The promise of the war-time experience for the post-war future, however, failed to totally materialize because of the character of industrial production and the curtailed modernization policies of local manufacturers, which led to the ultimate loss of tens of thousands of industrial jobs. Although the USWA gained significant wage increases for its members in the post-war years, thereby allowing them to participate fully in the upsurge characterized by the long post-war economic boom, it became engaged in a hard and ultimately losing struggle to save much of its districtwide membership from the circumstances of permanent layoff. While, in other words, the increased wages of post-war steelworkers allowed them to achieve a measure of prosperity unknown before the war, the elimination of many jobs within the local iron and steel industry in later years resulted in devastation for large numbers of wage-earners who could not completely replace the incomes which had led to their new found respectability.

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Notes:

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